

**ENGINEERING-SCIENCE, INC.**

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September 8, 1994

Mr. Marty Faile  
AFCEE/ERT  
8001 Arnold Drive  
Brooks AFB, Texas 78235-5357

RE: AFCEE Bioventing Test Initiative Final Tables

Dear Marty:

Please find attached final tables and site figures for several sites at which 12 months of bioventing pilot testing have been completed. Specifically, final tables and site figures are attached for Edwards AFB, California - Site 16 and Site 21, and Hanscom AFB, Massachusetts - Building 1812. Please note that soil and soil gas samples were not collected from the vent wells at both Site 16 and Site 21 at Edwards AFB. These samples will be collected in October 1994 during final sampling activities at Site 44. Updated final tables for Site 16 and Site 21 will be created and sent to you following receipt of analytical data.

Please call me or Doug Downey at (303) 831-8100 if you have any questions.

Sincerely,

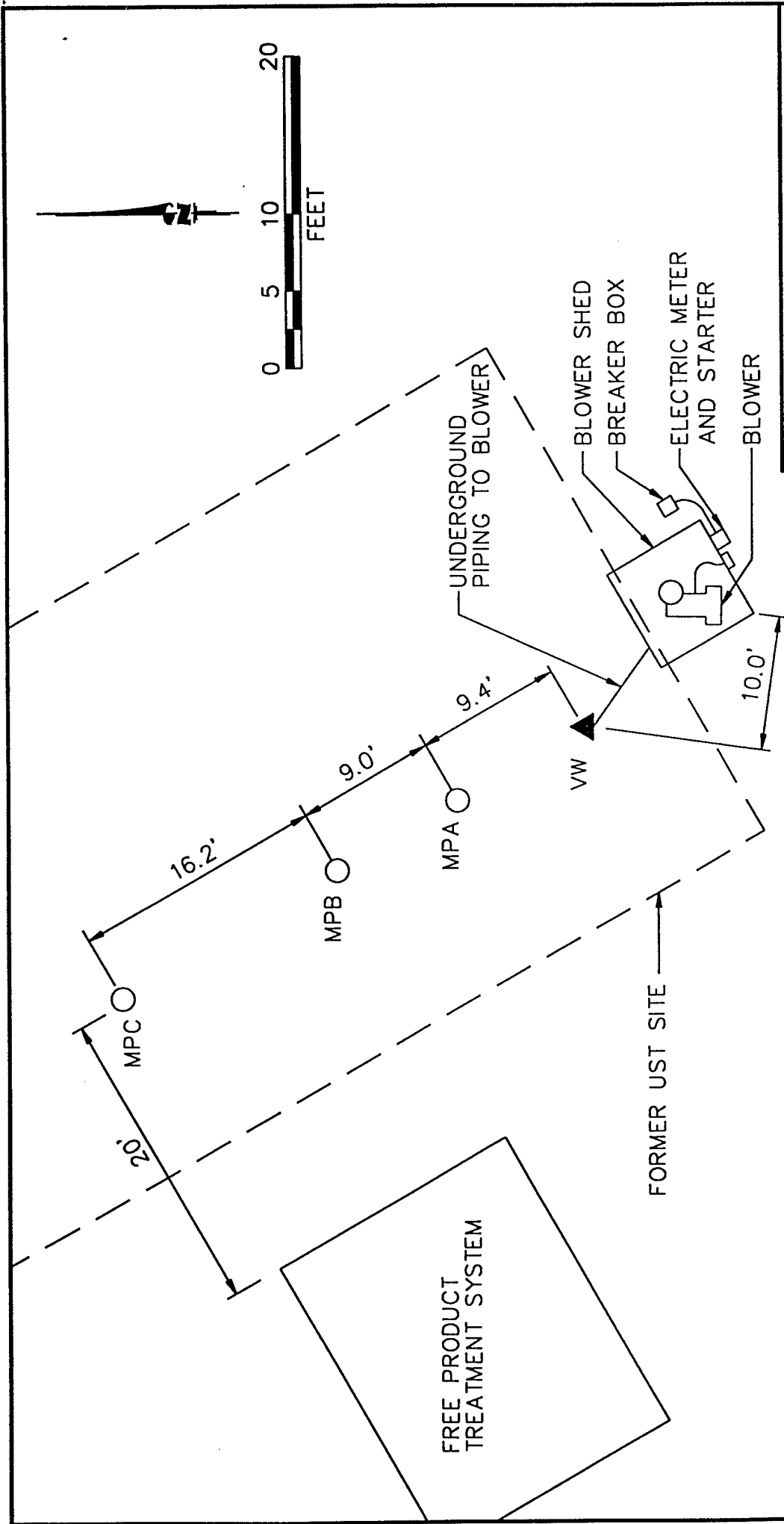
ENGINEERING-SCIENCE, INC.

*Brian R. Blicher*

Brian R. Blicher  
Environmental Engineer

c.c.: Doug C. Downey, P.E.  
File

**DISTRIBUTION STATEMENT A**  
Approved for Public Release  
Distribution Unlimited



# LEGEND

VW ▲ VENT WELL

MPA ○ MONITORING POINT

FIGURE 1

SITE 16

RECORD DRAWING  
PROPOSED VENT WELL/  
MONITORING POINT LOCATIONS

EDWARDS AFB, CALIFORNIA

ENGINEERING-SCIENCE, INC.  
Denver, Colorado

**TABLE 1**  
**SITE 16**  
**RESPIRATION AND DEGRADATION RATES**  
**EDWARDS AFB, CALIFORNIA**

Location - Depth (feet below ground surface)	Initial (Jan. 1993)			6 - Month (Sep. 1993) <sup>b/</sup>			1 - Year (Apr. 1994)		
	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year) <sup>a/</sup>	Soil Temperature (°C)	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)
VW	0.00029	43	NS <sup>c/</sup>	NS	NS	NS	NS	NS	NS
MPA-4	0.000008	<10 <sup>d/</sup>	11.4	0.000033	<10 <sup>d/</sup>	26.6	NS	NS	17.3
MPA-9	0.00046	<10 <sup>d/</sup>	16.9	NS <sup>e/</sup>	NS	24.2	0.00027	14	16.9
MPB-4	NS <sup>e/</sup>	NS	NS	0.000074	9.0	NS	NS	NS	NS
MPB-9	0.00039	91	NS	NS <sup>e/</sup>	NS	NS	0.00027	5.3	NS
MPC-4	0.00028	10	NS	0.00015	20	NS	NS	NS	NS
MPC-9	0.0017	390	NS	NS <sup>e/</sup>	NS	NS	0.0024	120	NS

<sup>a/</sup> Milligrams of hydrocarbons per kilogram of soil per year.

<sup>b/</sup> Assumes moisture content of the soil is average of initial and final moistures.

<sup>c/</sup> NS=Not Sampled.

<sup>d/</sup> Although limited oxygen utilization was measured in these points, high levels of soil moisture reduced the air filled porosity of the soil and limited oxygen supply to soil bacteria.

<sup>e/</sup> Water encountered at this location.

**TABLE 2**  
**SITE 16**  
**INITIAL AND 1-YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS**  
**EDWARDS AFB, CALIFORNIA**

Analyte (Units) <sup>a/</sup>	Sample Location-Depth (feet below ground surface)					
	VW		MPA-9		MPC-9	
	Initial <sup>b/</sup>	1-Year <sup>d/</sup>	Initial	1-Year	Initial	1-Year
Soil Gas Hydrocarbons						
TVH (ppmv)	39,000	NS <sup>d/</sup>	70,000	150	80,000	1,000
Benzene (ppmv)	150	NS	260	0.2	280	1.4
Toluene (ppmv)	28	NS	32	0.15	19	1.5
Ethylbenzene (ppmv)	17	NS	26	0.87	17	3.2
Xylenes (ppmv)	84	NS	140	3.7	42	6.9
Soil Hydrocarbons	VW-8.5		MPA-9.5		MPB-9.5	
	Initial <sup>e/</sup>	1-Year <sup>f/</sup>	Initial	1-Year	Initial	1-Year
TRPH (mg/kg)	13	NS <sup>d/</sup>	10	<6.0	50	6.4
Benzene (mg/kg)	<0.0034	NS	<0.76	<0.0006	<0.65	<0.0006
Toluene (mg/kg)	0.036	NS	<0.89	<0.0006	<0.76	<0.0006
Ethylbenzene (mg/kg)	0.053	NS	6.1	<0.0006	0.76	<0.0006
Xylenes (mg/kg)	0.26	NS	32	<0.0008	4.1	<0.0009
Moisture (%)	12.3	NS	21.3	17.7	7.6	19.3
					NS	17.3

<sup>a/</sup> TVH = total volatile hydrocarbons; ppmv = parts per million, volume per volume;

TRPH = total recoverable petroleum hydrocarbons; mg/kg = milligrams per kilogram.

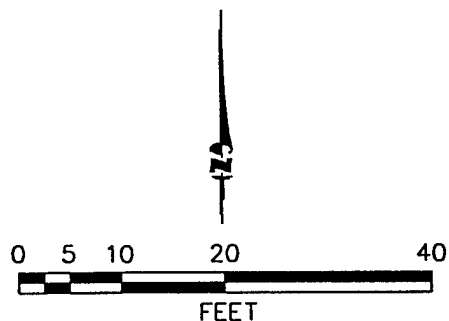
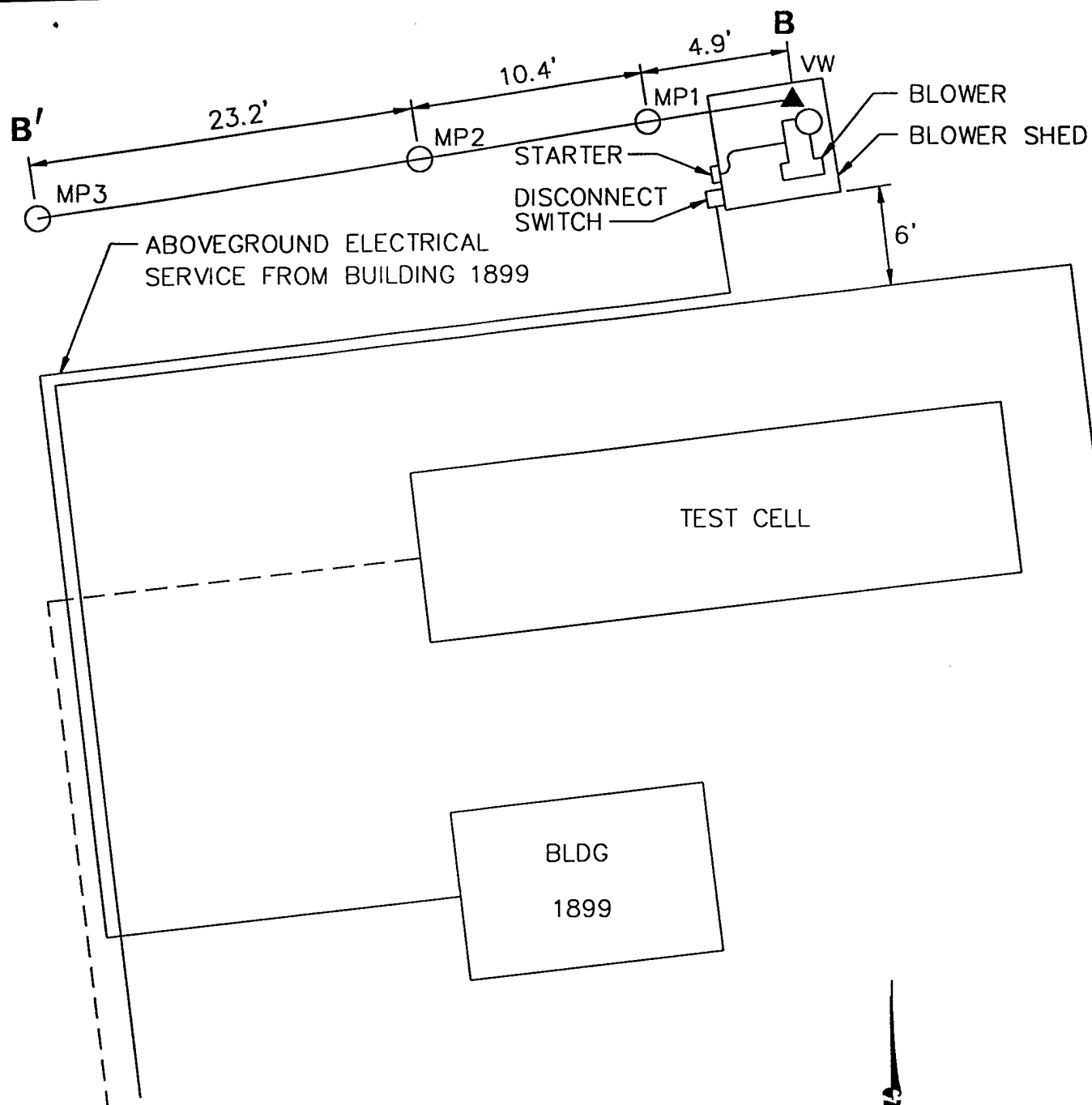
<sup>b/</sup> Initial soil gas samples collected on 1/9/93.

<sup>c/</sup> 1-Year soil gas samples collected on 4/4/94.

<sup>d/</sup> NS = Not Sampled. Field personnel did not sample vent well soils and soil gas. In October 1994 the soil and soil gas samples will be collected from the vent well. An updated table will be distributed subsequent to receipt of analytical data.

<sup>e/</sup> Initial soil samples collected on 1/7/93 and 1/8/93.

<sup>f/</sup> 1-Year soil samples collected on 4/11/94.



#### LEGEND

- VW ▲ VENT WELL
- MP1 ○ MONITORING POINT
- FORMER PIPELINE FROM USTs
- A — A' CROSS SECTION

SOURCE: ENGINEERING-SCIENCE, INC., 1989a

FIGURE 1  
SITE 21  
RECORD DRAWING  
VENT WELL/MONITORING POINT  
LOCATIONS

EDWARDS AFB, CALIFORNIA

ENGINEERING-SCIENCE, INC.  
Denver, Colorado

ES

**TABLE 1**  
**SITE 21**  
**RESPIRATION AND DEGRADATION RATES**  
**EDWARDS AFB, CALIFORNIA**

Location - Depth (feet below ground surface)	Initial (Jan. 1993)			6 - Month (Sep. 1993) <sup>b/</sup>			1 - Year (Apr. 1994)		
	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year) <sup>a/</sup>	Soil Temperature (°C)	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)
VW	0.0042	940	NS <sup>c/</sup>	NS	NS	NS	NS	NS	NS
MP1-7	0.0012	110	NS	0.00038	46	25.2	NS	NS	17.0
MP1-11	0.0051	460	NS	NS	NS	23.6	0.0045	720	17.3
MP2-7	0.0024	460	NS	0.00024	49	NS	NS	NS	NS
MP2-11	0.0025	490	NS	NS	NS	NS	0.0068	1400	NS
MP3-7	0.00096	220	NS	0.00019	40	NS	0.00012	30	NS

<sup>a/</sup> Milligrams hydrocarbons per kilogram soil per year.

<sup>b/</sup> Assumes moisture content of the soil is average of initial and final moistures.

<sup>c/</sup> NS = Not sampled.

**TABLE 2**  
**SITE 21**  
**INITIAL AND 1 - YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS**  
**EDWARDS AFB, CALIFORNIA**

Analyte (Units) <sup>a/</sup>	Sample Location - Depth (feet below ground surface)					
	VW		MP1-11		MP2-11	
	Initial <sup>b/</sup>	1 - Year <sup>c/</sup>	Initial	1 - Year	Initial	1 - Year
Soil Gas Hydrocarbons						
TVH (ppmv)	32,000	NS <sup>d/</sup>	67,000	43	48,000	400
Benzene (ppmv)	110	NS	300	0.025	150	0.5
Toluene (ppmv)	24	NS	<1.9	0.077	22	0.4
Ethylbenzene (ppmv)	9.9	NS	15	0.24	12	1.2
Xylenes (ppmv)	30	NS	45	0.63	38	2.7
Soil Hydrocarbons						
	VW-11.5		MP1-11.5		MP2-11.5	
	Initial <sup>e/</sup>	1 - Year <sup>f/</sup>	Initial	1 - Year	Initial	1 - Year
TRPH (mg/kg)	17	NS <sup>d/</sup>	240	7.3	70	26.5
Benzene (mg/kg)	<0.33	NS	<0.35	<0.0006	<0.0007	<0.069
Toluene (mg/kg)	<0.38	NS	<0.41	<0.0006	0.0008	<0.069
Ethylbenzene (mg/kg)	1.5	NS	3.2	<0.0006	<0.0006	<0.069
Xylenes (mg/kg)	6.5	NS	13	<0.0008	<0.001	<0.096
Moisture (%)	8.4	NS	15.0	11.9	9.8	9.1
					NS	7.4

<sup>a/</sup> TVH = total volatile hydrocarbons; ppmv = parts per million, volume per volume;

TRPH = total recoverable petroleum hydrocarbons; mg/kg = milligrams per kilogram.

<sup>b/</sup> Initial soil gas samples collected on 1/12/93.

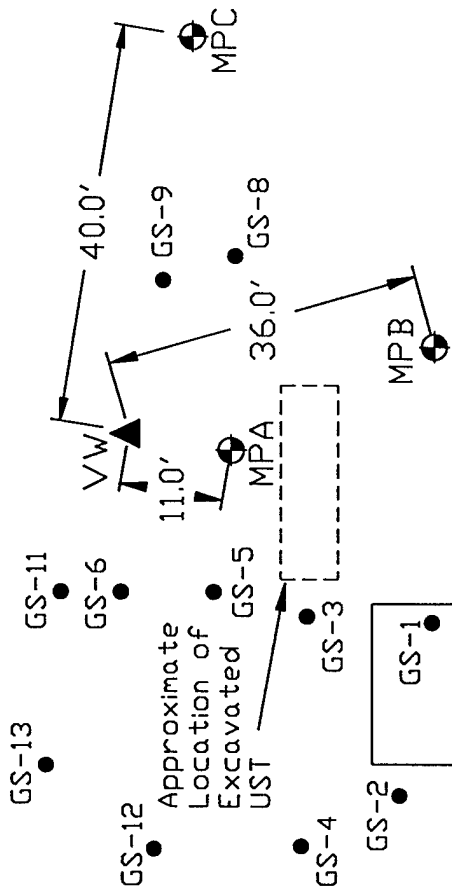
<sup>c/</sup> 1 - Year soil gas samples collected on 4/5/94.

<sup>d/</sup> NS = Not Sampled. Field personnel did not sample vent well soils and soil gas. In October 1994 the soil and soil gas samples will be collected from the vent well. An updated table will be distributed subsequent to receipt of analytical data.

<sup>e/</sup> Initial soil samples collected on 1/8/93 and 1/9/93.

<sup>f/</sup> 1 - Year soil samples collected on 4/11/94.

# BUILDING 1812



Not to scale

## LEGEND

- ▲ INJECTION VENT WELL
- ⊕ VAPOR MONITORING POINT
- SOIL GAS SURVEY POINT

FIGURE 1

## BUILDING 1812 AS-BUILT SITE PLAN

HANSCOM AFB, MASSACHUSETTS

**ENGINEERING-SCIENCE, INC.**

Denver, Colorado



**TABLE 1**  
**BUILDING 1812**  
**RESPIRATION AND DEGRADATION RATES**  
**HANSCOM AFB, MASSACHUSETTS**

Location - Depth	Initial (Oct. 1992) <sup>a/</sup>			6 - Month (June 1993)			1 - Year (March 1994) <sup>d/</sup>		
	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year) <sup>b/</sup>	Soil Temperature (°C)	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year) <sup>c/</sup>	Soil Temperature (°C)	K <sub>o</sub> (% O <sub>2</sub> /min)	Degradation Rate (mg/kg/year)	Soil Temperature (°C)
MPA - 2.5	NS <sup>e/</sup>	NS	NS	0.00081	320	19.7	NS	NS	NS
MPA - 5	NS	NS	NS	0.00039	170	17.2	NS	NS	NS

<sup>a/</sup> Initial testing was not performed by Battelle due to high oxygen concentrations.

<sup>b/</sup> Milligrams of hydrocarbons per kilogram of soil per year.

<sup>c/</sup> Assumes moisture content of the soil is average of initial and final moistures.

<sup>d/</sup> 1 - Year testing was not performed at this site due to atmospheric oxygen concentrations in soil gas 30 days after blower system was shut down.

<sup>e/</sup> NS=Not Sampled.

TABLE 2  
BUILDING 1812  
INITIAL AND 1 - YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS  
HANSCOM AFB, MASSACHUSETTS

Analyte (Units) <sup>a/</sup>	Sample Location – Depth (feet below ground surface)																																				
Soil Gas Hydrocarbons	NO SOIL GAS DATA COLLECTED <sup>b/</sup>																																				
Soil Hydrocarbons	<table><tr><td colspan="2">VW (3 – 3.5)</td><td colspan="2">VW (3.5 – 4.5)<sup>c/</sup></td></tr><tr><td>Initial<sup>d/</sup></td><td>1 – Year<sup>e/</sup></td><td>Initial</td><td>1 – Year</td></tr><tr><td>TRPH (mg/kg)</td><td>12</td><td>658</td><td>13000</td><td>2860</td></tr><tr><td>Benzene (mg/kg)</td><td>&lt;0.062</td><td>&lt;0.0006</td><td>&lt;0.0032</td><td>&lt;0.063</td></tr><tr><td>Toluene (mg/kg)</td><td>&lt;0.072</td><td>0.0013</td><td>0.015</td><td>&lt;0.063</td></tr><tr><td>Ethylbenzene (mg/kg)</td><td>&lt;0.052</td><td>&lt;0.0006</td><td>&lt;0.0026</td><td>&lt;0.063</td></tr><tr><td>Xylenes (mg/kg)</td><td>&lt;0.093</td><td>0.001</td><td>0.051</td><td>&lt;0.088</td></tr></table>				VW (3 – 3.5)		VW (3.5 – 4.5) <sup>c/</sup>		Initial <sup>d/</sup>	1 – Year <sup>e/</sup>	Initial	1 – Year	TRPH (mg/kg)	12	658	13000	2860	Benzene (mg/kg)	<0.062	<0.0006	<0.0032	<0.063	Toluene (mg/kg)	<0.072	0.0013	0.015	<0.063	Ethylbenzene (mg/kg)	<0.052	<0.0006	<0.0026	<0.063	Xylenes (mg/kg)	<0.093	0.001	0.051	<0.088
VW (3 – 3.5)		VW (3.5 – 4.5) <sup>c/</sup>																																			
Initial <sup>d/</sup>	1 – Year <sup>e/</sup>	Initial	1 – Year																																		
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Xylenes (mg/kg)	<0.093	0.001	0.051	<0.088																																	
Moisture (%)	3.2	5.7	6.1	0.5																																	

<sup>a/</sup> TRPH = total recoverable petroleum hydrocarbons; mg/kg = milligrams per kilogram.

<sup>b/</sup> No soil gas samples were collected from this site.

<sup>c/</sup> Initial soil sample taken from 3.5-4 feet bgs, 1-year soil sample taken from 4-4.5 feet bgs.

<sup>d/</sup> Initial soil samples collected on 10/3/92.

<sup>e/</sup> 1 - Year soil samples collected on 3/23/94.